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NUTMEGS.

Nutmegs and mace are the products of *Myristica fragrans*, Houttyn, a bushy tree, sometimes attaining the height of forty feet but commonly much smaller. The leaves are lanceolate dark-green, firm and shining. The flowers which are either male or female are small and bell-shaped with acute points to the sepals, and yellow in colour.

As a rule each tree is either male or female, and this is only distinguishable by the flowers. The female flowers are solitary, and much larger than the males and thicker in texture. If opened they will be found to contain a pubescent cylindric pistil cleft at the top into two short thick styles. The male flowers, on the other hand, are produced in little racemes of three or four and each contains a column of stamens all joined together.

Some trees produce both male and female flowers in various proportions, and it is well known that trees on their first flowering bear male flowers only, after about two years will sometimes produce female flowers and eventually bear no males.

Female trees are naturally of the greatest value to the planter, but it is of course essential to have some male trees in the plantation, or the fruit will be of no value. Even without males the fruit will sometimes set and develop up to a certain point, but never ripens and soon falls off. The pollen is conveyed from male to female flowers by small insects, chiefly apparently a very small flattened, brownish beetle, but bees often visit the flowers as well.

The fruit takes nine months to ripen. It is of the shape of a peach, about 1½ inch through. The husk which is thick and fleshy and pale yellow in colour, splits when ripe showing the black seed wrapped in the bright crimson network called the aril or mace. Between the mace and the nutmeg, however, is a thin, brittle shell which is the testa or outer seed covering.

There is usually one seed to each nutmeg, but sometimes two are to be found, this is called Pala Bacambar or Pala Kende-kende. Irregularly shaped seeds are called Pala Penchuri, and in cases where the seed is no bigger than a pea and the mace very large, Pala Raja. White nutmegs, that is to say, with uncoloured mace and usually brown, hardly black seed, are called Pala Putih and Pala Hollanda. These are all forms produced by imperfect fertilization. Rumphius describes also a variety called Pala Kackerlack, in which the seed variegated yellow and red, and Pala Domine in which the mace only partially covers the seed.

Except for these abnormalities there can hardly be said to be any variety in the nutmegs. Double female flowers however not rarely occur, they consist of two flowers fasciated together, that is to say, joined together by their edges so as to form one broad flower.

There are very many kinds of wild nutmegs in the Malay Peninsula and the Archipelago but none are of any value as spice except the long nutmeg *Myristica fatua* (Houtt.) which is imported from the Moluccas. It is not cultivated at least to any extent, and is of little reputation, so that it would not repay cultivation.

Some of the wild nutmegs, however, being very large trees, produce a good second quality timber and are known as Pendarahan Pendarah, Chenderah, etc.

History of the Nutmeg.

The nutmeg was known as a spice very early, at least as early as A. D. 540, and perhaps even earlier, being imported by Arabs from the East Indies, and seems to have been brought into Europe through Aden towards the end of the twelfth century. It was then used with other aromatics for fumigating as well as in spicery, and was very expensive, a pound of mace costing as much as three sheep. The Portuguese discovered the tree in Banda in 1512, and held the monopoly of the spice till the Dutch a century later took the Spice Islands. The latter tried to confine the cultivation to Banda and Amboyna and attempted to exterminate the trees elsewhere, but it is said that the fruit-eating pigeons carried away the seed and scattered it about the other islands, so that they were unable to entirely confine the trees as they wished.

So much spice did they accumulate in the early years of their occupation, that an immense quantity was burnt at Amsterdam in 1760 to keep the price up.

In 1796 the English occupied the Spice Islands and eventually in 1819 Sir Stamford Raffles introduced it together with cloves into Singapore. It had previously—about 1806—been introduced into Penang.

The value of the spice was then very high, the import price of mace into London in 1806 being 85 to 90 shillings a pound with a duty of 7 shillings and a penny on the pound.

At first the cultivation was very successful and a good account of it is given by Dr. Oxley in a paper printed in Logan's Journal in 1848. Dr. Oxley had then cultivated the trees for twenty years. At this time there were over twenty-four plantations in Singapore containing 55,925 trees, of which, nearly fifteen thousand were in full bearing giving a return of over four million nutmegs a year.

In 1860 there were 14,500 acres under spices in Penang and Province Wellesley and they were yielding 30 to 40 pounds per acre. But in that year commenced the nutmeg disease which was so destructive as to nearly annihilate the cultivation in these places and, in fact, did entirely stamp out the plantations in Singapore. In Penang and Province Wellesley the Chinese re-started the cultivation and it goes on there to this day. In Singapore it quite died out, though a few persons still retained a small number of trees, and recently one planter has recommenced cultivation with every prospect of success.

Good plantations can also be seen in Malacca (at Pringgit), and in Johore (at Pengerang) and in a few other spots.

The nutmeg has also been cultivated in Ceylon, India, Brazil and the West Indies, especially in Jamaica, where it seems likely to do well. Also in French Guiana and Reunion; but, with the exception of Jamaica and Trinidad, these localities seem to have proved unsuitable and the cultivation a failure.

The Dutch islands of the Malay Archipelago have, of course, always supplied the greater number of nutmegs in the market, Banda and the neighbouring islands producing the largest amount and the best nutmegs.

The cultivation was introduced into Sumatra in 1798, and an account of it by J. Lumsdaine, dated 1820, was published in the Tropical Agriculturist. It does not seem to have been a very great success, and has more or less died away since.

There is, I think, little doubt but that the plant is a native of Banda and the neighbouring islands though Forrest states that it is wild in New Guinea. These Spice Islands are of volcanic origin, and the rich soil suits the plant well. It is clear too, I think, that the tree thrives best near the sea, which seems to confirm the theory of its island origin.

Cultivation.

Soil.—The soil in which the nutmegs are grown in Penang and Province Wellesley is the ordinary yellow, loamy clay on the slopes of the bigger hills, and the more friable this soil is the better the trees seem to grow. In stiff clay or sandy soils they do not thrive. Oxley says that the deeper the tinge of iron in the soil the better for the plant, and is inclined to think that is almost necessary for the full development of the tree. This, I think, is correct. The Pringgit plantation in Malacca is on a hard ferruginous gravel and the trees there thrive remarkably well. At Bencoolen, Lumsdaine says that the soil of the plantations was generally a red mould with stony fragments or pebbles scattered through it, the surface in the forest lands being of a chocolate colour. The Banda soil is a rich volcanic earth. The soil, therefore, should be friable with plenty of iron in it. Bare clayey hill slopes are not suitable on account of the heavy rainwash, but rocky broken up slopes like those of Penang and Province Wellesley, seem quite suited for it. Here, however, the plants have to be terraced as the slopes are too steep to grow the trees or otherwise and this is very expensive work. Small walls of granite boulders are built on the slopes and these filled with earth serve to support the trees. Alluvial soil is recommended by Lumsdaine, and, doubtless, would prove satisfactory so long as water did not accumulate there as often happens in the Malay Peninsula.

Shade Trees.—In Banda the nutmegs are grown under the shade of large Kenari trees (*Canarium commune*). In Penang and Malacca shade trees are never used, the amount of space at the planter's disposal being too small for him to use them, and indeed it would often be difficult to grow shade trees on these steep slopes.

A correspondent in the Tropical Agriculturist writes (1889—June 1, p. 840): "It has been found that without sufficient shade the "young nutmegs suffer considerably; with it failures are less, the "growth is quicker, prospects of a return are good and the time about "seven years. The cost of upkeep is next to nothing, except to keep "the trees free from parasites hardly anything has to be done."

I am inclined to think that where possible it would be very advantageous to use shade trees. They would serve to protect the

nutmegs from excessive heat and light and from injury to the flowers and fruit by storms of wind and rain. The Chinese on the exposed slopes of the Penang Hills find it necessary to put up screens of coconut leaves in many places to protect the fruit from being knocked off by blasts of wind before it is ripe. LUMSDAINE points out that it is essential to protect the plantations from strong winds by belts of trees, but deprecates the use of large trees on account of their excluding sun-rays and dew, and robbing the soil of its fecundity. The finest looking trees I have seen in the Straits have been isolated trees under shade. They had been quite neglected and never manured but the ground beneath was covered with turf, but I doubt if these specimen trees fruit as well as smaller, more exposed ones.

Shade trees would, I think, prevent besides a good deal of the rain wash, and would aid in retaining humus, and in this way would save in the matter of manure.

The Kenari tree (*Canarium commune*) is not a native of the Straits and is rarely planted. Probably Erythrinas, Albizzias, and Adenanthera would be the best to use for shading here as they grow well and rapidly. The nutmegs throw their roots very high so that in all probability, trees which root pretty deep would interfere less with the roots of the nutmegs. On one occasion I saw some nutmegs which had been planted among coffee bushes, but the coffee roots soon found their way into the manure destined for the nutmeg and ended by killing them.

It has been suggested that planting nutmegs along tracks cut through big jungle would be found satisfactory and would be well worth trying. The plan, however, has certainly the objection that the trees and fruits would suffer much from the depredations of deer, pigs, monkeys, squirrels and other animals which would be very difficult to keep down where the jungle was extensive. However it must be remembered that all wild nutmegs are jungle trees, and love the shade, and though we do not know in what kind of localities the cultivated kind grew when in a wild state the presumption is that it was a jungle tree like the others.

Seed.—The nutmeg seed for planting should be carefully selected, and only large well formed ones should be taken. Pale colored or abnormally shaped seed should be rejected. It is said by the Chinese that seed with rounded backs produce female trees while those with a ridge along the back will produce males, but I doubt that this is more than a superstition.

The seed is planted in beds shaded with attaps a foot apart, and watered every other day or oftener according to the dryness of the soil. They will not keep very long and it is best to plant them within a day of gathering. If it is necessary to keep them or to send them any distance, they should be put in dry earth, or powdered charcoal.

They will germinate in a month or six weeks, or sometimes longer. They grow at first slowly and when they are about six inches tall can be transferred to the plantation.

They should be planted about thirty feet apart. The ground should be well broken up between the trees and cow-dung, and

burnt-earth may be mixed in. Dr. Oxley recommends that the holes should be at least six feet across and four feet in depth, but it is not usual to make holes of such a size. Well broken up soil with cow-dung and burnt earth should be mixed in the hole, which should be filled up to a foot higher than the surrounding land to allow for sinking, otherwise when the ground settles and sinks, water will collect round the plant and injure or kill it. The young tree should be shaded for some time after planting, till it is strong enough to stand the sun alone.

After planting the young trees, little requires to be done in the way of cultivation, beyond the manuring. Where necessary the trees should be pruned, suckers and erect branches being cut off. The nutmeg tree bleeds very much when cut, and wounds do not seem to heal up as well as in many other trees.

Dr. Oxley recommends that a cement made by boiling two parts of pounded chalk and one vegetable tar be applied warm to cut surfaces. Ordinary tar, however, will do well enough if the chalk is unprocurable. Otherwise the rain is liable to set up decay on the cut surface and beetles of different kinds will attack the dying wood and probably injure the tree.

Moss, if very abundant, and creeping ferns should be removed from the trees, and the mistletoes (*Loranthi*) should be extirpated. These are very destructive. The seeds are passed by birds on the branches, germinate and send their roots deeply into the wood quickly killing the branch they attack. To merely break off the branches of the mistletoe, as the Chinese often do, is of little use, as the stem or a portion of it and the roots remain in the tree and continue their destructive work. Any bough with mistletoe on it should be cut off a little below the spot where the parasite is growing. This effectually kills it. All dead or dying boughs should be removed and burnt as soon as possible. Under no circumstances should they be left lying about in the trees or on the field. It is through carelessness and neglect of this point that the nutmeg beetle can get a hold of a plantation and soon ruin it. It would be preferable to leave no decaying wood on the grounds at all. All sticks and stumps could well be burnt and the charcoal used for manuring the trees.

Manure.—The question as to what kind and how much manure to use for nutmegs is one that seems to have vexed planters much.

In Banda, it appears that the trees are not manured at all, but as the soil in the Peninsula is very poor, and unlike the rich earth of the volcanic islands, it is certainly necessary in most places at least to use manure.

It was suggested by Mr. José d'Almeida in Collingwood's article on the destruction of the plantations in 1860, that the trees had been killed by over-manuring. That the trees had been unnaturally forced by digging trenches too closely around the spongioles and by too rich and long continued manuring by which heavy crops had been obtained, but which at last exhausted the tree. This may have acted injuriously on the trees, but there can be very little doubt that the disease had an entirely different cause, namely, the nutmeg beetle, which is described later.

Forcing any tree with strong coarse manure especially where much ammonia is used, will usually shorten the life of the trees and, as was pointed out in the same paper, while in Penang where the planters were rich and could afford much manure, the destruction was complete; in Malacca where the people were poorer and could not afford so much manure, the trees did not suffer so severely. As mentioned elsewhere, I have seen trees which, apparently, never were manured and certainly have not been manured for many years which were exceptionally fine specimens, but this may have been due to other causes. Under the ordinary system of cultivation, that is to say, the bare exposed hill slopes, manuring of some kind seems absolutely essential.

In Penang and Province Wellesley refuse fish is used as manure, but the preference is given to prawn dust, the shells of the prawns used in making the well known Malay condiment, Belachan. Each tree receives from eight to ten catties a year. It is dug into the ground once in the year at a point just outside the spread of the branches, in a circle all round the tree. This prawn dust costs from $1.80 to $2 a pikul.

Some planters in the district use also bat-dung from the limestone caves of the Langkawi Island. It is imported by junks, and is rather expensive, one hundred of the small baskets called *"sodo"* costing three dollars.

Dr. Oxley states that he used some tons of guano, then a new manure, on his trees, and found it unsatisfactory, the least beneficial substance which can be given to the tree. "It causes the tree to assume a deeper colour of foliage and to throw out shoots, but there comes on an unpleasant reaction." He was also inclined to think that the quality of the fruit deteriorated.

Some Chinese in Province Wellesley used the urine collected from coolie lines, and some used night soil. It is said, however, that if these manures are once used on a tree, it is necessary to continue always to use it or the tree fails. In fact it appears that too strongly ammoniated manures are not at all suited for nutmegs, and such manures as guano, fish refuse, night soil and urine should be either used sparingly or better in combination with other manures. Pig dung collected beneath the styes in the usual Chinese method is most approved of by the planters. Dr. Oxley got the best results from dead animals buried near the trees, blood, fish and oilcake imported from Java. For young trees he used liquid fish manure. He also recommends that the husks of the nutmegs should be thrown into the manure pit, but these are now often used for preserves.

Cow-dung and stable manure, well rotted, seem to be very suitable, and in many places in the Peninsula are practically the only local manures obtainable as well as the cheapest. In Malacca, a cart-load of cow-dung is thrown at the foot of each tree once a year and a little soil raked over it.

In planting new trees the Chinese often dig a trench three feet deep all round the young plant and fill it with cut grass which is then covered up.

As the nutmeg throws its roots very high (the larger ones being

partly above the ground) and produces eventually a very thick network of them in the soil surrounding the tree, it is better not to attempt to trench the ground for manuring or many of the roots will be cut and much injury caused, but to put the manure on the ground as is done in Malacca and let it soak in. The ground if hard can be pricked over previously, to aid in its absorption by the roots. This plan has been used in Ceylon according to a correspondent to the Tropical Agriculturist.

Some of the better class of Chinese cultivators throw cut lalang grass on the ground beneath the trees to protect the roots from excessive sunheat. This seems a very reasonable procedure, as the grass not only protects the roots but as it decays form a manure to the plant, and besides it appeared to me that plants thus treated were less liable to attacks by the beetle. Dead leaves might be also used in like manner.

Cropping.—The trees should begin to produce fruit in from the ninth to the tenth year, not earlier than the seventh or eighth.

Some trees begin to bear sooner even in the third or fourth year, but this is highly undesirable as the tree will crop itself out too soon.

In Banda three crops a year are taken, one at the end of July or in August, one in November and one at the end of March or beginning of April. The first is considered the best crop. Here the trees fruit all the year round irregularly, and the fruits are collected daily.

The fruit takes nine months to ripen and is known to be mature by the splitting of the husk which shows the seed a full black covered with the brilliant red mace. The fruit is collected by hand or with a three-pronged stick by which it is twisted off. Forbes in his Wanderings of a Naturalist, p. 287 gives a drawing of a rod with two deflexed prongs with a basket beneath used for gathering the fruit in Banda but there the trees are far bigger than they ever grow here.

The trees in the Moluccas are said to last for 70 or 80 years, but in the Straits, they do not last so long. They are, as a rule, at their best when 15 years old and will fruit well for ten or twenty years after that.

Each tree in full bearing should give ten pounds weight of nutmegs a year and one pound of mace, and reckoning seventy trees to an acre this would give 700 pounds of nutmegs and 70 pounds of mace an acre.

Duration of Trees.—The trees in Banda are said to attain a height of 50 feet and to last for 70 years. Here they are much smaller and about twenty feet tall is the usual height of a good tree. These fruit, however, long before they attain to this height. Strong trees are compact and regular in outline, the leaves of a deep glossy green. If the branches are are spindly with few leaves and the leaves are yellowish green it may be taken that the plant is starving and weak. Such trees are very liable to attacks of vermin and the fruit is often abnormally shaped or does not ripen.

Male and Female Trees.—The proportion of male and female trees in a plantation is of considerable importance to the result so

that it would be of the greatest importance to be able to detect early the sexes of the young plant. Unfortunately there is no certain distinguishing point except in the flowers, and as these are not, as a rule, produced for six years, it follows that a planter may be disagreably surprised after that time at finding too large a proportion of the trees are males. However it must be remembered that many trees which at first produce male flowers only, will later produce a few, then more females and finally become a female tree altogether.

Prestoe in the Royal Asiatic Society's Journal, states that in Trinidad male trees occur more numerously than female to the extent often of 15 per cent. But I think that, as a rule here, the larger number of trees produced are female. He also states that there is a difference in the leaf the female being most perfectly elliptical with straighter primary veins; the male leaf is broader towards the point than at the middle, that is, of obovate shape and furnished with a point much longer than that of the female, and the veins are curved in towards the point much more roundly than in the female.

The Chinese in Province Wellesley and Penang cut down all the trees in the plantation that do not produce fruit, or produce but little. That is to say, they destroy all pure males, and expect the fruit to be fertilized by the few bisexual trees they leave. I have also seen fine and healthy young trees destroyed which had produced no fruit within the time the owner expected, but which with pruning probably would have become the finest and longest-lived tree in the plantation. In Malacca, male trees are not destroyed unless there are too many. No manure is wasted on them and they often looked ragged and shabby but produce abundance of flowers.

The result of the destruction of males in the plantation is seen in the diminished crop, more flowers falling unfertilized, and in the production of *white nutmegs*.

White Nutmegs are those in which when the husk splits the nutmeg is seen to be brownish and quite soft while the mace is white or merely tinted with red. These nutmegs are, of course, useless. Sometimes a tree is said to produce nothing but white nutmegs, causing a great loss to the planter. On comparing some white nutmegs with normal ones, I found that the embryo was much smaller, and in two cases I could not find it at all.

I was shown by the Chinese spots on the husk of the white nutmeg which were supposed to be the cause of the disease, but these appeared to be mere decay spots on which a mould was growing. They often did not even penetrate deeply into the husk and in but few cases had affected the mace. The fruit unfertilized had evidently begun to decay on the tree without falling, as it would have done if it had been fully fertilized and ripened. It is probable that some of these white nutmegs are partially fertilized but the amount of pollen was insufficient for the ripening of the fruit. There may be other causes for the nutmegs not ripening completely such as injury of some kind to the tree, starvation &c., but I believe that imperfect fertilization is the chief cause.

Proportion of males to females.—Prestoe in the paper above alluded to recommends keeping one male to eight or ten females

but one to twenty is apparently quite sufficient. The males should, of course be scattered about the plantation and not allowed to be all in one place, that is to say, in cutting out the excess of males, those in suitable positions for fertilizing the females should be retained. A few pure males in the plantation will be far more effective than a number of hermaphrodite trees, although the latter may give a few fruit.

Enemies.—The nutmeg tree possesses many enemies of more or less importance, but none is so destructive as the *Nutmeg-beetle.*

This very small insect, belongs to the group of *Scolytidæ.* All of which are bark or wood-eaters, and some of which such as *Scolytus destructor* have long been known as among the most destructive insects to trees.

It is only $\frac{1}{8}$ inch in length, a short cylindrical beetle, especially convex above with a small bent down head, sunk thorax and ornamented with a brush of yellow hairs. The antennæ are clubbed, the club being whitish. The rest of the beetle is deep brown appearing black. Its wing cases are strongly ribbed with a row of raised dots between each rib. The grub is very small and white. There seems to be two species at least, which live together in the tree. One which is much smaller than the other is the most destructive, and is the one which attacks the branches as well as the under ground part of the stem. The beetle deposits its eggs beneath the bark of the tree, either at the base of the trunk below the ground, or in the branches. The grub attacks the cambium or living layer between the bark and the wood. When it attacks the branches, it burrows at the base of the twigs, cutting away the cambium where the twigs join the main branch. In this case the twigs die speedily, the lowest first, and the leaves do not fall but dry on the twig, so that boughs may be seen with all the lower twigs bearing dead leaves while the upper twigs are still alive. After burrowing round the base of the twig, the grub often bores into the centre of the wood. The beetle remains for some time even weeks in the boughs and will, unless destroyed, attack other parts of the tree.

The subterranean portion of the trunk is next attacked, and sometimes even before the boughs show any signs of the presence of the beetle. Usually the injury to the base of the tree is overlooked till the disease has reached above ground when it is almost too late to save the tree, and it is commonly said that a tree attacked dies in ten days. In Collingwood's description of the destruction in 1860, which was, I have little doubt, caused by this pest, it is said that a tree would be attacked in the night and the morning light would show its topmost branches withered. In reality, doubtless, the tree had been attacked weeks, perhaps months, before, but the injury was not noticed till the tree was at the point of death.

As the beetles work away from the part of the tree they have killed into still living parts, many other wood-eating beetles attack the dead portions, usually longicorn beetles and hasten the work of destruction. For some reason, the nutmeg-beetles in attacking the base of the tree only attack it on the side facing the greatest amount of light. As in Penang and Province Wellesley the trees are usually planted on terraces on the hill slopes, the attack usually

takes place on the side of the tree farthest from the hill slope, so that dying trees may be seen to have the bark destroyed in a line along this face, and all the boughs on that side will be dead.

The beetles probably breed very fast, as thousands may be seen in a single tree.

The Disease in 1860.—That this insect was the cause of the disease in 1860, I think there can be little doubt. I quote Dr. Collingwood's account:—"In the night a tree would be attacked and "the morning light would show its top-most branches withered; the "leaves fell off; the disease slowly spread downward *chiefly on one* "*side of the tree* (the lower portion often for a long time green and "bushy) the tree became one unsightly mass of bare and whitened "twigs. No situation was exempt from its ravages; hills and valleys "alike suffered, nor could any principle be traced in its promiscuous "attacks." Upon a close examination of diseased parts it is found that the *formative layer inside the back dries up and turns black;* the leaves then wither and fall off and soon the bark is found to be full of small perforations, but no insect of any kind has ever been discovered in connexion with the change nor has any fungus been charged with the destruction. Its nature has been a mystery and a puzzle to the planters who, for the most part, in vain sought for a cause either near or remote and whose efforts to arrest it have proved entirely unavailing".

I have italicised the passages which seem most strongly to point to the disease being caused by the beetle. The death of the tree from the top downwards is very characteristic of destruction caused by injury to the roots or what is equivalent the ringing of the tree at the base. This is confirmed by the blackening of the cambium layer, which, cut off from the roots by the beetles having destroyed the subterranean portion, soon dies. The small perforations in the bark should have shown the planters that small beetles were at work. The only question then could have been whether these were *ante-mortem* or *postmortem* attacks. This point is settled by finding the beetles in the living bark, and especially in the living branches. Had Penang possessed an entomologist at that period, the cause of the disease would probably have been at once detected, and the destruction quickly arrested. As it was, to quote Collingwood again, "the planters abandoned the plantations in disgust in many cases "while there were still numerous healthy trees and the land reverted "to Government. In other cases where expensive bungalows had "been built upon the estate, they were sold for a small proportion "of the sums expended in building them since they were, as a rule, "too far from town to command any competition and ceased to be "conveniently situated. Many planters both English and Chinese "whose whole estates were invested in nutmeg plantations were thus "reduced to ruin and absolutely penniless, and distress and disap-"pointment everywhere prevailed."

Many of the trees which were abandoned and round which a thick jungle undergrowth sprung up recovered, which Collingwood attributes to their being no longer manured. This is exactly what might have been expected. The beetles were unable to find their way to isolated trees mixed up with undergrowth and brushwood.

This is quite characteristic of these clumsily flying insects. Every coconut planter knows that isolated and exposed trees are the first to be attacked by the coconut beetles, strong flyers as they are, and that the greatest damage is invariably done on the outer edge of the plantation.

It is probable in the cases of badly attacked trees where the beetles are very numerous that the insects were nearly all bred from a few which had flown to the tree and breeding rapidly there had produced the enormous colony that destroyed it.

Remedy.—To stop this destruction it is necessary to rigorously burn all branches attacked, and all dead sticks and trees. In the case of the latter the stumps which may still contain beetles should be dug up and burnt.

The Chinese do not, as good cultivators would, cut off and burn the dead branches but leave them in or under the tree, and often when any boughs die and they do cut them off, they leave them piled up on the ground or even use them to bank up the earth for young trees, absolutely bringing the pest to the newly planted seedlings. As I have found the beetle living six inches deep in the ground burying the boughs does not kill the beetle which can very quickly dig its way out.

The irregular way in which trees in a nutmeg plantation are attacked is very remarkable. I have seen three trees standing side by side on a terrace destroyed utterly, while all round them and quite close to them were trees in the finest condition with no signs of any beetles even in the branches. But these injured trees were standing on a very exposed part of the slope, well above the tops of those on the lower terraces, so that the beetles flying as beetles so often do in a straight line across the valley would naturally strike these trees first.

As is almost invariably the case in attacks of this kind, the disease begins with the destruction of a few branches, and the cultivator takes no notice of this. The beetles increase in numbers, a few trees die, still no notice is taken, then almost suddenly the disease becomes virulent, every tree is attacked and quickly dies, and the planter in despair abandons the plantation leaving the dying trees to spread the infection.

It is imperative, therefore, to prevent the beetles from increasing in such numbers that they become unmanageable, and this can be done by destroying all sticks which can furnish them with a breeding ground.

It is more difficult to destroy or prevent the beetles from attacking the underground part of the stem. I observed that the better class of cultivators were in the habit of covering the ground with cut lalang beneath the shade of the tree. This not only protects the roots which lie very high from excessive heat and supplies them with a certain amount of nourishment, but also appears to prevent the beetles from finding their way to the base of the stem. For I noted that trees thus treated suffered less from beetles.

Planting grass or turfing beneath the trees would probably have a good effect on them, as it does on most trees here, but there is always a certain amount of difficulty in manuring trees where the

ground is turfed so as to get the manure to the tree roots. Planters might also try the effect of tying brushes of beaten-up coconut fibre round the base of the tree so as to reach to and over the ground and these might also be tarred, and simple tarring of the base of the tree would probably have a deterrent effect on the pest.

If, however, by neglect a tree has got badly attacked and it may be considered to try to save it, all affected bark should be cut off and burnt, and tar or whitewash liberally applied, and the underground part of the stem, which it is by no means easy to get at on account of the close network of roots, could be treated by picking over the soil so as to loosen it close to the tree and pouring there a strong solution of Tuba root, or London purple and water might be poured down.

The difficulty here is to induce the Chinese planters to take any trouble about the disease of this kind. As long as a diseased tree bears one or two fruits they will not destroy it, and it so happens that dying trees often produce a large number of fruits—a last expiring effort of nature.

To a good cultivator the disease presents no insuperable difficulty of eradication, and it is very remarkable that in 1860 the nutmegs were allowed to perish if, as I gather from COLLINGWOOD's account, this was the only real disease to which the nutmegs were subject.

OTHER ENEMIES.

The *Mistletoes* (*Loranthus*, spp.) are very destructive to the nutmegs, if allowed to grow upon them as is the case in neglected plantations. These parasites push their roots down the branches on which the seed has been dropped by a bird, and very soon kill them. They must be destroyed by cutting off the branch just below the spot where the mistletoe is growing. It is of no use to merely break off the boughs of the parasite as I have often seen done, for it will presently start growing again. The bough must be cut off.

The *Creeping fern* (*Drymoglossum piloselloides*) though it is not a parasite but merely creeps on the bark, should be pulled off as it is very injurious.

Some trees I have seen of which the leaves were thickly covered with orange coloured *galls*, bun shaped, about one-eighth of an inch across. From a number of these I bred two descriptions of insects (*Cecidomyia*, sp.) and a hymenopterous gallfly, apparently a *Cynips*. These gall insects appeared only to attack weakly and sick trees.

Picking the diseased leaves off and burning them, at the same time manuring the tree, is the best remedy for this.

Blight.—A coccus is also not rare on weakly trees, but appears to do little harm. If excessive the leaves can be washed with tobacco water and soft soap, or phenyl in water, thrown on by a bamboo squirt or syringe.

Caringas.—Dr. OXLEY considered the common red ants (*caringas*) objectionable on account of their fastening the leaves of the tree together to make their nests, which leaves, he says, turn yellow and die, and on account of their biting the nutmeg collectors. He recommends hanging a portion of some animal substance such as

fowl's intestine on a pole in the tree when the ants run along the pole in thousands and collect on the bait when they can be easily burnt. These ants however, are an almost invariable sign of there being blight on the tree. The blight insects they carry into their nest and lick off the sweet honey-like liquid secreted by them. They may at times introduce the blight to the tree for this purpose, and so act injuriously. At the same time they are so destructive to caterpillars and many other noxious insects that they are rather to be encouraged than otherwise.

Spangle scale.—In a nutmeg plantation in Malacca, I found a very beautiful silver scale insect on the nutmeg leaves. It seemed to be rare and I have only once seen it since. The Chinese considered it quite harmless. These animals suck the juice of the leaf with their beaks, and, if abundant, may be injurious.

Aphis or greenfly may also be met with on weak or sickly trees. I have also met with a *leaf mining caterpillar,* but it was not common. Dr. Oxley, however, who appears to have seen the same thing, says that these insects rapidly spread and cause great havoc.

The *Mango-borer.*—The Chinese often plant mangoes in or near the plantations and these trees are invariably attacked by the mango-borer, a moth caterpillar red in colour, which burrows up the branches causing them to die and fall off. The caterpillar resembles that of the English goat-moth (*Cossus Ligniperda*) on a small scale. When there are not sufficient mango trees for the moth to deposit its eggs on, it will attack the nutmegs and injure or kill them in like manner.

As mango trees produce few or no fruit here it is not worth while to cultivate them, and they should be rigorously excluded from nutmeg plantations.

I have also seen a leaf-fungus on the leaves of sickly trees and a small pyschid caterpillar, one of those that makes a kind of case for itself out of bits of leaves. It was eating the stigma of the female flowers, and, of course, would prevent fertilization by the destruction of this important female organ, but these pests only occur rarely and at present do but little harm.

Planters must remember, however, that any of these enemies may, under suitable circumstances, become virulent, even if they at present do but little harm, they should be watched to prevent their getting a complete hold of the plant.

Dr. Oxley mentions:—"a very small mothlike insect that is apt "to infest young plants, laying its eggs on the leaf where they be- "come covered with yellow spots and perish if not attended to "speedily." I have never seen anything like this nor can guess what kind of an insect he means. He recommends washing with a decoction of Tuba root. He likewise seems to have had trouble with white ants and urges the planter to clear out old stumps and roots of trees out of the ground, and recommends the use of pig-dung for dislodging them. I have already in a previous Bulletin described the action of termites with respect to living plants.

Products of the Tree.

The Husk.—This is used for making preserve by boiling it with

plenty of sugar so as to form a jelly, which is of a red colour and very pleasant in flavour. The husks are also sliced and salted and used as a stimulant to thirst. Salted nutmeg husk is often to be seen at the lower class of drinking shops where it is supplied for this purpose. The husks fetch in Penang about ten cents a large basket.

Mace is prepared by merely drying it in the sun in flat basket trays. The Dutch sprinkle it with salt water before drying it, but this does not seem to be of any advantage to it. Though red when fresh it usually becomes orange when dry, and this colour is preferred. It should be entire, flattened, horny and of a good colour. Penang mace still fetches the highest price in the market, about 2*s*. 9*d*. a pound.

It is chiefly used as a spice, rarely in medicine. It has a pungent spicy taste different from that of the nutmeg and contains a distinct volatile oil consisting largely of a principle known as macene.

Nutmegs.—The husk and mace having been removed the nutmegs are dried on hurdle frames over a low wood-fire at a temperature not exceeding 140 degrees with a proper circulation of air. After about two months the seed is dry. Dr. Oxley recommends that at first the nuts be exposed to the sun for an hour or two each day, increasing it gradually for eight or ten days and then transferring them to the drying-house. Too much heat makes the seed to shrivel and spoils it for the market. When quite dry the kernels rattle in the shell, and then the latter is cracked with a wooden mallet and the seed taken out. If taken out too soon they are liable to the attacks of a beetle which spoils them.

The nutmegs are then sorted, bad ones rejected, and the good ones rubbed over with a little dry lime. Sometimes the testa is not broken but the seed exported in the testa. They are said to keep longer like this, but it adds one-third to the weight, and consequently adds to the expense of shipping. The Dutch method of dipping the seed in a mixture of saltwater and lime and then drying in the sun, is condemned now by most exporters.

Penang nutmegs are imported unlimed, but it is said that there is so much prejudice in favour of limed nutmegs, that unlimed nutmegs have sometimes to be limed in London for purposes of exportation.

The nutmegs are then packed in casks which have been smoked inside and then coated thinly with a mixture of lime and water.

Nutmegs are valued by size, the largest about an inch long by four-fifths of an inch across, weighing four to the ounce fetch the best price. Penang produces the best nutmegs as well as the best mace, the larger sizes valued at 2*s*. 9*d*. a pound.

Uses.—The seed is, of course, chiefly used as a spice, and also in medicine for dyspepsia and diarrhœa, but in large doses is narcotic and dangerous.

About a fourth of the seed consists of fat, commonly known in trade as oil of mace, or nutmeg butter, which contains an oil Myristicene.

Nutmeg butter is chiefly made in Penang, from small or damaged nutmegs. These are reduced to a coarse powder, placed in a bag

and exposed to the vapour or water, and afterwards pressed between two heated plates. The oil runs out as a liquid but sets into a mass like butter on cooling. It is made up into blocks about ten inches long and two and-a-half inches square and wrapped in leaves. Two pounds of nutmegs have given as much as nine ounces of oil, *i.e.*, 28 per cent.

The nutmeg butter is used in rheumatism and in cases of sprains and in the manufacture of pitch plaster. It is somewhat acrid and will blister the skin if rubbed in for some time.

Beetles Injurious to Nutmegs.

A circular note from Mr. Hart of Trinidad, gives a list of beetles found attacking nutmegs prepared for market. They are *Trogosita Mauritanica* Lam., *Tribolium ferrugineum*, Fabr., *Carpophilus*, sp., *Loemophlacus*, sp., *Hypothemenus*, sp., *Lasioderma* (near if not identical with *L. testaceum*, the well-known cigar beetle). Mr. Blandford says that the first two are probably the really injurious insects. They are well-known destroyers of flour, meal and all sorts of warehouse goods, and in the case mentioned by Mr. Hart, it was found that imported horse or cattle food had been stored in an adjoining room and probably the beetles had been brought in in this food. All are very small beetles, the first, which is the largest, measuring $\frac{3}{8}$ths inch in length. Treatment with lime seemed to protect the nuts to a large extent.

Grain of all kinds being very liable to attacks of these little beetles, should be kept away from the nutmegs as much as possible.

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CLOVES.

The cloves of commerce are the unopened flower buds of the Clove-tree, *Eugenia Caryophyllata*, Thumb., one of the order *Myrtaceæ*. The plant is a small bushy tree usually about 20 feet tall, with small polished lanceolate bright green leaves, very aromatic. The flowers are produced in bunches on the end of the branches.

It is a native of some of the smaller islands of the Moluccas, where it has long been cultivated. Cloves were very early brought into trade, being known in China about 266 B. C., and in Europe by the fourth century.

The Dutch in the seventeenth century having driven the Portuguese out of the East Indies, endeavoured to keep the clove traffic in their own hands and to confine its culture to a few islands, but eventually the clove tree was carried to various parts of the world, and the greater part of the trade is now from Zanzibar.

Besides in the Spice Islands (the Moluccas) cloves are cultivated in Java, Sumatra, Penang and other parts of the Straits, Zanzibar and Pemba, Reunion, Jamaica and Dominica.

Cultivation.

The plant is raised from seed, almost invariably, but it is said to be possible to propagate it by layering. The layers are said to take root and commence to grow in six months after putting them down.

The seed is planted in nurseries, and the plants are transplanted when about six inches tall. They should be planted not less than twenty feet apart, and as the clove is very sensitive to water at the roots, care should be taken, after the soil is made and mixed with manure in the hole in which the plant is to be put, to raise the centre of the ground into a mound so that when it settles down a depression will not be left round the young tree in which water will collect.

Soil.—The tree requires a fairly rich soil whether clayey or gravelly. It does not thrive in stiff, yellow clay unless it is well broken up and manured. The black soil of the valleys here suits it well, unless, as often happens, there is a water bed at no great depth. Some trees planted in such spot in the Botanic Gardens, after growing well to about twelve feet in height, began to die, and eventually many perished. On digging the trees up it was found that the roots had come to a water-bed, and had curled and bent in a very remarkable way to avoid the water, but unable to get into dryer soil, they had rotted and so the trees died. It is often said that cloves require sea-air, and, without doubt, the tree grows best near the sea.

Manuring.—The trees nearly always require manure here on account of the poverty of the soil. The most suitable manure is cow-dung, but prawn-dust may also be used.

Little requires to be done to the trees beyond manuring, except to prune off useless branches and to destroy the Mistletoes (*Loranthus*) which sometimes attack them.

In some places it is customary to top the trees to a height of eight or nine feet, for convenience in gathering the cloves. But in most parts of the Peninsula the trees have a tendency to keep about twelve feet tall, and as they generally flower most on the lower boughs, topping is not considered necessary.

The trees begin to bear when about six years old, but as a rule require eight years' growth before they fruit properly.

Enemies.—The worst enemy I have seen here is the borer mentioned in the last Bulletin, a black caterpillar with yellow rings, which burrows into the branches and kills them.

I have seen also a root-fungus, resembling a white mould, which grows upon the roots and soon proves fatal. This however, seems to be rare. The Mistletoes (*Loranthi*) also attack clove tree as they do nutmegs and do much damage if neglected.

In Penang, I have also found the curious climbing yellow parasite *Cassytha* injuring trees near the sea. It can be easily pulled off the trees, and being exclusively a sea-shore plant, can only attack trees close to the sea.

Collection and Preparation.

The flower-buds are fit for gathering when they have taken on a red colour, and before the small white petals have expanded. They are usually gathered by hand, but in the Moluccas are beaten into cloths spread below with bamboos. They are then spread out to dry in the sun on mats. In some places they are dried on a slow wood fire, and some persons scald them in hot water before drying, but this is not common, and is not likely to produce a fine sample. Some of the finest cloves ever shown in the Straits Agricultural Shows, were dried on zinc plates by heat. When they are somewhat brittle they are dry enough for packing.

The best cloves are large and but little wrinkled, and of a light purplish brown. Dull, black, shrivelledc loves are considered inferior. A good deal depends on the buds being quite full-sized when gathered, and their being dried carefully so that they shall neither go mouldy by insufficient drying nor become brittle and shrivelled by too rapid drying.

Adulterations &c.—It is not easy to adulterate cloves, but it appears that at one time they were manufactured in America out of soft deal stained and soaked in essence of cloves then imported into Zanzibar and thence shipped to London.

Clove stalks are exported from Zanzibar for adulterating ground cloves and for mixing with mixed spice. They contain clove oil but only about a quarter of the amount in the clove, and are valued at about 3 or 4 pence a pound.

Mother cloves, the fruits of the clove are also exported but fetch even a lower price than clove stalks.

Trade prices.—The difference in value in samples of cloves is very great, size and colour making a great variation in price. The best samples are supplied by Penang, and sell for 9*d.* a lb. or even more, while the inferior Amboyna fetch about 4½*d.* and Zanzibar and Ceylon as low as 1¾*d.* per pound.

Of late years there has been an increase in the export of

cloves, from 2,222 pikuls in 1891 to 4,096 in 1896, but a large proportion of these are imported from Zanzibar through Bombay. The import to the United Kingdom amounts to from one to four million pounds annually, chiefly from Zanzibar.

Uses.—Cloves are used chiefly as a spice, also in medicine for dyspepsia and also for toothache. In European medicine when used it is chiefly used in the form of clove oil. The Natives use cloves in chewing betel either as cloves, or mixed into the gambier cakes.

CINNAMON.

Cinnamomum zeylanicum L., (*Laurineæ*).—The cinnamon grows remarkably well in the Straits Settlements, and might be cultivated here with profit were it not that at present Ceylon seems able to supply all that is required. A little is also produced in Brazil and French Guiana, and a considerable amount in Java and Southern India.

The tree is usually a small one about twenty feet tall, but attaining a height of forty feet in exceptional cases. It is bushy and compact, the leaves usually ovate, deep shining green. The flowers are produced on short spreading panicles on the end of the branches, often in great profusion, they are small and yellowish white in colour. The fruit is of a deep purple black. The seed is collected when ripe, and piled up till the pulp rots off, washed and dried in the shade, and planted in nursery beds about a foot apart and shaded, being watered every other day or as often as needed. When about six inches tall they can be planted out, at eight to ten feet apart.

The seedlings take two or three years before they are fit to cut, and the plantation will not give much return before four or five years, at least.

The most suitable soil is said to be siliceous soil with a mixture of vegetable mould. Marly soil is said to produce an inferior bark.

The plant can also be propagated by cuttings of shoots and by layering, which are said to be quicker in result than raising from seed.

The bushes are not, as a rule, manured, at least in Ceylon, but where the soil is poor as in Singapore, it would probably be beneficial to do this. The weeds, however, are changkolled up and dug into the ground near the bushes.

Cutting.—The shoots are cut when eighteen months or two years old. They are from half to three quarters of an inch thick, and from three to five feet long. The cutter first makes a slit in the bark to see if it separates freely from the wood, if not the shoot is left. The tops and branches are chopped off and left, the sticks tied in bundles and carried off to peel. "Peeling is per-
"formed with a round pointed knife having a projecting point on
"one side for ripping. The peeler takes a stick in the left hand
"draws a longitudinal slit from end to end and works the knife
"between the bark and the wood till he has raised it about half an
"inch wide, then turns the stick and draws another slit parallel to

"the former and working the knife on that side detaches the slip "and so proceeds rubbing such sticks as do not peel freely with a "piece of hard wood."

The pieces are packed one inside another, in bundles about eight or nine inches wide, and piled up and covered with a mat. On the morning of the second day the cuticle is scraped off the slips of bark. They are sorted, trimmed, and selecting a suitable slip for the "pipe" the "pipe maker" packs in it as many bits as it will close over when dry. These "pipes" of bark are laid out to dry in a shed, and afterwards are spread out in the sun, but protected by mats or kajangs to dry.

In Ceylon the peeling seasons are May and November just when the red young leaves are turning dark green, as at this time the sticks peel easiest. (Ferguson, All About Spices, p. 205.)

The seasons are rather irregular in the Straits, but the change of the leaf can be taken as a sign that the trees are ready.

The trees are pruned as soon after the cutting as possible. All wood of more than two years' growth, crooked shoots and superfluous branches being cut out.

The chief enemy of the cinnamons here is a very common borer, a red caterpillar which burrows into the stem in much the same way as the clove-tree borer. It, however, attacks chiefly at least the wood of the full grown trees, and would hardly interfere with the shoots of properly looked after plantation.

The cinnamon bushes last for a long time. Some in Ceylon a hundred years old are said to bear as well as ever, "and the same soil has grown cinnamon for 2,000 years."

It may be questioned whether cinnamon could be grown to profit in the Peninsula as long as the amount produced in Ceylon and Java is so large.

In 1851, Mr. Butterworth, then Resident Councillor of Malacca, found on Pringgit Hill near Malacca, some cinnamon trees stated to have been planted some years before. He had 27 lbs. of bark prepared and shipped to England for valuation. The samples proved on the whole good, considering that the trees had been quite neglected, and on the strength of that report it is said that a number of Malacca planters started cultivating cinnamon, but apparently it was soon given up.

WILD CINNAMON.

Cinnamomum iners, Reinwardt, is a very common tree in secondary jungle and waste ground, especially in the South of the Peninsula. It so closely resembles the cultivated *Cinnamon* (*C. zeylanicum*) that it has been considered a variety only of that plant. The most conspicuous difference in the two trees lies in the form of the leaves which are rounder and more ovate and smaller in *C. zeylanicum*. In the real cinnamon too the leaves are of a much darker green colour and stiffer in texture. The wild cinnamon here has little or no aroma or taste in bark or leaves, and what flavour it has is somewhat different, being slightly bitter, but some trees are more aromatic than others. The Natives here use the bark for spicing curries.

Kulit lawan (*C. Culit lawan* Bl.) a slender branched cinnamon with small leaves lanceolate with rather a long point, which produces a very aromatic bark used chiefly in Native medicine. It occurs in Perak.

Medang Lawang (*C. Sintoc*, Bl.) is one of the largest of the wild cinnamons, attaining the height of fifty or sixty feet. The bark is used by the natives, and is very aromatic. It is not at all common in the Peninsula.

C. javanicum, Bl., is a very similar species, having large leaves, a foot long, woolly on the back. It is very aromatic also, and though scattered over the jungles is by no means plentiful.

C. Parthenoxylon, Medang Kamangi or Kayu Gadis, is a big tree belonging to the Camphora section of cinnamon, with smaller round leaves. Is used in native medicine. It is common in Penang and Province Wellesley.

CASSIA.

There are several kinds of cassia bark in trade which are imported into Europe from China, Calcutta, Java, Sumatra and the Philippines.

Of these, the most valued is the Chinese cassia bark, *Cassia Lignea* or Chinese Cinnamon, the produce of the tree known as *Cinnamomum Cassia*.

This is a fairly large tree, attaining a height of about forty feet, and a foot or more through. The leaves are oblong in form of a deep shining green colour, about six inches long and two inches broad. They have the characteristic three parallel veins of the cinnamons, from all other kinds of which the tree can be readily distinguished by the large size of the leaves and the peculiar aromatic flavour.

The tree grows remarkably well in the Straits Settlements in almost any soil, but has never been cultivated here, nor apparently anywhere except in China and perhaps Java.

Cassia is one of the oldest known spices, if not the oldest, being mentioned in a Chinese herbal dated about 2700 B. C. and having been imported into Egypt as early as seventeenth century B. C.

Cultivation.—Nothing was known as to the source and cultivation of cassia, till Mr. Ford of the Hongkong Botanic Gardens, went to investigate it up the West River, Canton. He found it cultivated on the sides of hills, terraced for the purpose, from altitudes of 300 to 1,000 feet above sea level. Apparently it was not cultivated on the plains because there was but little level country in the district and that was wanted for rice and vegetables. The soil selected was that bearing the thickest growth of grass and fern, with a fair quantity of humus.

In the Straits, the trees grow well in the ordinary yellow clayey soil, at low levels.

In China, the trees are planted three feet apart and not manured. They are cut after six years. The branches, about an inch thick, are cut to within a few inches of the ground. All the small twigs and leaves are cleared off, a large bladed knife like a budding knife is used to make two longitudinal slits and three or four

incisions at sixteen inches apart round the circumference of the bark, the bark is then loosened by passing beneath it a kind of slightly curved horn knife with the two edges slightly sharpened. Pieces of bark, sixteen inches long and half the circumference, are thus obtained. The epidermis is planed off the outside of the bark. It is allowed to dry for twenty-four hours and tied up in bundles for sale. The leaves are dried and eventually distilled to produce cassia oil. The twigs are used by the Natives. The cassia buds of commerce are the unripe fruits gathered when one-eighth grown.

The demand for cassia is not very large, and present prices in London are about 24*s*. to 30*s*. per cwt.

BLACK PEPPER.

Pepper is one of the earliest known of spices and was in use as early as the fourth century B. C. During the middle ages it was considered the most important of spices, and it contributed more to the development of the trade to the East Indies than any other product. It was first cultivated in Malabar, where it is wild, and its cultivation was carried to the Malay Archipelago in the different century. As the Malayan trade developed the Indian decreased so much that in 1889 while 28,041,096 pounds were imported into Great Britain from the Straits Settlements, only 514,298 pounds were imported from India and Ceylon. The greater part of the pepper exported from Singapore comes from Sumatra, Rhio, Java, Siam, Sarawak, Johore, Selangor, Sungei Ujong and Malacca. In India, Malabar and Kanara still produce a certain amount, and, it is cultivated also in Ceylon, Zanzibar, Mauritius, French Guiana, and has also been tried in Western Africa, and, in fact, in most tropical countries. Owing, however, to over-production, the value of pepper of late years has fallen, and in some of these countries the cultivation has naturally been neglected.

The soil preferred here is the usual yellow stiff clay which is so common in Johore and Singapore and slopes in full sun are selected. Wet or sandy soil does not suit the plant at all, and in very rich soil, it is said that the vine runs too much to leaf. The reason for growing on sloping ground is that water may not lodge at the roots of the plant, in damp weather.

Cultivation.—Pepper is practically always grown from cuttings, but it can be raised, if necessary, from seed. For this purpose, perfectly ripe seed should be taken, steeped in water for three days to get off the skin, put into a mixture of red earth, cow-dung and water, and exposed to the sun for three days, then the seed is planted in an earthen pot every grain being separate, and watered every day until the stalk has four leaves, when it can be planted out four to each tree or post (*Indian Agriculturist—Sept., 1878*).

For cuttings it is essential to take them off from the top of a bearing vine as those from running shoots will never produce fruit. The cuttings are about a foot or eighteen inches long, made

from strong branched shoots, all superfluous shoots being taken off. In the Straits, it is usual to grow the vines on stout wooden posts or roughly cut bits of timber about ten feet tall, made of any available hard wood, burnt or tarred at the base to keep off white ants as much as possible. But in India and elsewhere it is trained up trees planted for the purpose especially Erythrinas, Jack, Cashew-nuts, Betel-nuts, Mangos, or Cotton trees. The Erythinas (Dadup) are most popular, as they grow fast from cuttings and the bark is rough enough for the pepper to cling to. Attempts have been made to grow pepper on rocks, the objection to which is that they are likely to be killed if there should be a period of excessive drought, or heat. Suggestions have been made to grow the plant in the form of a bush in the manner in which grape vines are grown in many places, but I cannot learn that this plan has ever been found successful.

The posts are put about eight feet apart and the cuttings after having been rooted in a shaded nursery bed, are planted in the hole which has been previously prepared with cow-dung and burnt earth. Two to four cuttings are planted to each post. During its growth, burnt earth and charcoal are placed at the roots from time to time. Cow manure may be added, but too strong manuring causes the plant to run to leaf. It is usual in hot weather to throw cut lalang on the ground between the posts, in order to protect the roots from excessive sun heat, and to afford some little manuring. Where gambier is also cultivated, as it commonly is in the Straits, the used gambier leaves are put on the ground instead of the lalang, The cuttings are tied at first to the posts with bast, till they have got a hold of the post. When the pepper has grown to the top of the post it is taken down and coiled round the base of the stump and covered with earth, so that it throws out numerous shoots which re-ascend the post; sometimes it is necessary to repeat this operation. When about three feet tall, again the shoots are topped, so that it shoots out laterally. The object of this is to cover the post; if it is not properly done, the vine will run to the top of the post, the lower part being bare of leaves. A properly grown plant has a conical outline, being thickest at the base, and the whole post is densely covered with leaves.

It requires three or four years to reach the top of the post, and usually begins to bear before this. When it is fruiting, liquid manure may be supplied to it. The plant should be full grown in about five years, and will bear for a great number of years if properly looked after.

Full grown vines should produce about four pounds of dried pepper per crop, and, cropping twice a year, eight pounds a year. An acre should produce 28 pounds a year.

Enemies.—These are not many. Blight (*Coccus*) will occur on weak ill-nurtured vines. A few caterpillars will eat the leaves, and there is a beetle the larva of which sometimes does much damage by burrowing up the shoots, chiefly the lowest ones and killing them. The presence of this insect is marked by shoots turning black and dropping their leaves. These should be at

once removed and destroyed. I have only seen it in a few plantations, and have not seen the adult insect.

A fungus attacking pepper in Mysore is described in Kew Bulletin, 1895, p. 178. The fungus is allied to *Dematophora necatrix*, a well-known destroyer of vines and orchard trees. It usually attacked the pepper vines at the roots, and appears on the stems as very minute black lumps and black velvety patches, the fruiting conditions of the fungus. All plants diseased should be at once burnt, and where the roots have been attacked, the soil must be sterilized with lime and wood ashes. Fires are recommended to be made in the neighbourhood of the infected vines, and where the disease is spreading from a centre by the underground mycelium or spawn, the infected portion is to be isolated by digging a narrow trench ten inches deep round the diseased patch.

Cropping and Preparing.—The fruit spikes are gathered when there are a few red fruits on them. They are put in a basket or wire sieve and plunged in boiling water, and then spread out to dry on mats in the sun. Frequently the scalding of the pepper is omitted, the fruit being dried directly in the sun, or with fire-heat, if necessary. It is then rubbed to get rid of stalks and waste pieces and to separate the pepper-corns and packed.

The prepared pepper should be clean and free from dirt and dust and the pepper-corns firm and of fair size. If gathered too young, they are small and shrivelled.

White pepper is made from ripe fruit left for a few days to ferment and then rubbed or trampled on to get off the outer coat, washed and dried in the sun. Decorticating machines are also used for cleaning the white pepper.

Adulteration.—Pepper as it appears in the home market is more liable to adulteration than almost any other product. Pepper dust which consists of small pepper corns and the husks rubbed off in making white pepper is adulterated with all kinds of rubbish, and long pepper is so much used for adulteration of ground pepper, that its price rises and falls with that of black pepper. Wild peppers, rice, spent ginger, ground olive-stones have all been used as adulterants of ground pepper, and the fruits of a common climbing shrub (*Embelia ribes*) are said to have been used to mix with pepper-corns in India.

Trade.—During the past six years the export of black pepper has fluctuated to a certain extent. The largest quantity from Singapore was exported in 1892, viz., 327,969 pikuls: since then the amount has declined steadily to 248,414 (in 1895). The largest quantity of this is shipped to Great Britain and the United States. White pepper was exported in greatest quantity in 1892, viz., 68,073 pikuls, and then declined, rising again in 1895. From Penang the greatest amount of black pepper was shipped in 1894, viz., 167,186 pikuls, and white pepper reached its maximum of 60,091 pikuls the same year. As the bulk of the pepper imported into Penang is derived from Achinese ports, the amount varies with the quietness and disquietness of that country.

At present the price of pepper is very low. Black pepper being

quoted at $11.12½ per pikul, in Singapore. This is, doubtless, due to over-production in past years. Pepper is a spice which keeps very well, so that a large import may choke the market for a considerable time.

The effect of the low prices has been to drive much of the pepper cultivation out of Singapore, the Chinese having turned their attention to indigo, pine apples and other products. But the diminution of cultivation here has also been partly due to the difficulty of procuring pepper posts, and wood to make burnt earth and charcoal for manuring it.

Pepper, like gambier, requires the use of a great deal of wood, and the clearing of all the woods in some of the districts where pepper and gambier were cultivated has done much to drive the planters away. I have known several cases where fire was raised among the grass in order to obtain the ash of the grass, sticks and dead trees for the pepper, the natural result being that many young trees were burnt uselessly and much damage done to the ground.

SIRIH.

This is the leaf of *Piper Betle*, L. A strong growing climber with large ovate ,dark green, shining foliage. It is much cultivated for local consumption in Singapore and other parts of the Malay Peninsula. The plant grows very easily from cuttings and is usually planted on stakes like ordinary pepper. The leaves are used for chewing with areca-nut, and in native medicine. There is a great demand for them, and they are sold at the rate of about ten leaves for a cent. Some Natives chew as many as fifty leaves in a day, and the demand and easy cultivation of the plant make it a very remunerative business. The leaves are used in a fresh state, but can be preserved for a fortnight or more if wrapped in sheaths of plantain. There are two well-known varieties—Sirih China, which has light green leaves, and Sirih Malayu with dark green leaves with reddish backs. The Chinese sirih is less liked by Malays as it is too coarse and strong in flavour. Rumphius states that this is due to the Chinese using night-soil for manuring, but plants cultivated in the Botanic Gardens under the same conditions keep their differences, slight as they are. The sirih seldom fruits and some of the plants in flower and fruit which have been figured or described as *Piper Betle*, L., appear to be quite distinct.

CUBEBS.

Piper Cubeba, L.—This pepper has been known and imported into Europe ever since the eleventh century. Till the beginning of the present century the drug was only used as a spice, and its medical properties though known to the Arab physicians of the middle ages, appear to have been quite unknown to European medical men till 1815, when the importation into Europe, which had long ceased, was recommenced. Java and Sumatra had always been the source of cubebs, and the Dutch were very careful to prevent other colonies from cultivating the

plant. However, a comparatively few years ago plants were procured and cultivation commenced in the Straits, notably at Pengerang Estate. Cubebs then were fetching a very high price, but they rapidly declined in value falling from £20 to £22 in 1886 to 32s. 6d. per cwt. in London in 1896.

The cubeb plant is a climbing pepper, remarkable among the cultivated peppers for the two forms of leaves. The long barren stems bear rather distant heart-shaped leaves of a deep green colour, about two inches in length. Those of the fruiting stems are long and narrow lanceolate in outline and very unequal at the base. The plants are unisexual, *i.e.*, the male and female flowers are on different plants, so that it is essential to have plants of both sexes in the plantation. The male spikes are slender and rounded, the females longer and thicker with the pistils projecting all round. The fruits are round like those of black pepper but are borne on stalks, whence the old trade name of tailed pepper.

The plant is grown and treated in much the same way as ordinary pepper, *i.e.*, on stumps or pepper posts or on tree trunks, and manured in the same way.

The fruit is gathered before it is ripe scalded and dried in the sun. The best commercial cubebs have undeveloped seed, those which the seed is developed are usually rejected, although they have a much better general appearance than the shrivelled seedless husks which are considered so much more valuable.

From most other peppers cubebs are distinguished by the presence of a stalk to the fruit. But there are several wild peppers which have also stalked fruit and belong to the same section as the cubebs. The commonest one is the dog pepper (*P. caninum*), which has been cultivated by mistake for cubebs. The berries of this plant is very much smaller than those of the true cubebs, and much shorter stalks.

The chief use of cubebs is as a drug in venereal disease, but valuable as they are, their use has been replaced by other methods of treatment and so have fallen in value. They have also been used in America in the preparation of asthma cigarettes. (Kew Bulletin, 1887, Dec., p. 1.)

LONG PEPPER.

There are a number of peppers in which the fruit instead of being in the form of distinct berries, is very small and crowded into compact cylindrical heads, so that they cannot be separated without breaking the spikes up. These are the long peppers, of which three are more or less used as spices. The most important of these is the Long pepper of trade, Chabei of the Malays, (*Piper officinarum*, C. De C.) It is not cultivated in the Straits but is imported from Bali, Java and other Dutch islands. It has a cylindrical spike about one inch and a-half long, tapering to the apex, and of a whitish dusty colour when dry. It is chiefly used for adulterating black pepper, and rises and falls in price with it. It is also used by Natives as a spice, and especially for chewing

with betel. Most of the long pepper imported into Singapore is exported again to India, comparatively little being sent to Europe. About ten thousand pikuls are imported and exported annually in the Straits. The value of it at present is only $4.50 per pikul, but this is probably mainly due to the fall in price of black pepper.

KADOK.

Piper longum, L.—This is a low growing plant often to be seen creeping on banks and in waste places in villages. The barren stems creep along the ground but the flowering stems are erect and about six inches tall or sometimes larger. The plant never climbs as most of the other peppers do. The leaves are ovate, cordate, polished, dark green. The small white flower-spikes are borne on the upper part of the stem, they are short cylindrical and erect. The fruits are very minute and resemble those of the true long pepper, but are always of a dull grey colour when ripe. The spikes of fruit are much shorter and rather thicker than those of long pepper and blunt at the end, not tapering as in the case in long pepper.

The plant is seldom if ever cultivated, but small patches are to be seen in every village, and it grows exceedingly readily in any shady spot. It can be propagated by cuttings with great ease. Kadok is used more by the Natives as a medicine than a spice, both the spikes of fruit and the roots being used. According to Rumphius the leaves are used in Amboina to cook eels with and the roots chewed with betel-nut for cough and asthma, and with ginger and betel-nut for toothache.

BAKEK.

Piper chaba, Hunter, is a climbing pepper which is cultivated to a small extent in the Straits in the same way as ordinary pepper. It is a climber with large oval leaves acuminate at the apex and unequal at the base, on stalks an inch long. The flower spikes are long and slender, on stalks an inch long. The fruit spike is over three inches in length, cylindrical and red when ripe. It is very pungent, and is much used for chewing with betel.

CHILIES.

Chilies or Capsicums are the produce of several species of *Capsicum (Solanaceæ)*, which, though, without doubt, natives originally of South America, have been cultivated in the Old World for a very long period. The kinds most commonly cultivated are:—

C. fastigiatum, Blume.—The bird pepper, a small shrubby plant, easily known by its very small fruits which are conical and less than an inch long. They are remarkably hot and pungent. This is a very popular chili with the Natives and is largely cultivated, and dried for use. It is said to supply the greater part of the pod pepper in the London market.

C. annium, L., long chilies, is a rather larger plant in all its parts. Its pods are much larger, two or three or more inches in length. cylindrical, conical. There are two forms, one with erect, the other (*C. longum*) with pendulous fruit. This pepper is often cultivated in Singapore and is much used in making Cayenne pepper.

C. grossum, Willd., is a variety of *C. annium* with very large broad, conical pods, less hot than most of the other kinds. It is chiefly used as a vegetable, for stuffing with force-meat.

C. baccatum, the cherry capsicum, has globular fruit like small tomatoes in shape. It is very pungent and is used for pickling and as a vegetable.

All the capsicums are very easily cultivated from seed which can be raised in beds and pricked out when a few inches tall. They are usually planted on ridges like indigo. The plants begin to fruit about four months after planting and continue for some months.

The fruits are gathered when ripe and dried over a fire. Cayenne pepper is made by drying the fruit in an open pan, and pounding it in a mortar, then grinding to powder. The powder is sometimes mixed with flour and made into biscuits with leaven, baked quite dry and then ground and sifted (Haldane. Sub-tropical Cultivation, p. 149.)

Chili Vinegar is made by steeping chilies, preferably the small bird pepper, in vinegar, and a very pungent and strong sauce, known as Devil Sauce is made by steeping them in strong brandy and filtering.

Trade.—Although chilies might be easily grown here in any quantity a considerable amount are imported from India, the present cultivation not supplying the needs of the place. Zanzibar seems to supply the greater part in the English trade. Prices at present are rather low from 30*s.* to 37*s.* 6*d.* per cwt.

VANILLA.

The cultivation of the vanilla has received but little attention in the Straits Settlements. Once or twice small lots have been planted, but I never heard any reports as to their results. In the Botanic Gardens both of the best kinds of vanilla are planted viz., *Vanilla planifolia*, Andrews, and *V. Pompona*, Schiede, and both kinds have produced flowers and fruit.

V. planifolia, Andrews, a native of Mexico, is distinguished by its thinner, oblong leaves and entirely green flowers, the lip being yellowish green. This kind produces the finest and most valuable fruits. They are longer and more slender than those of the other species.

V. Pompona, Schiede, a native of Central America, Trinidad and Guiana, has broader and thicker leaves, and the flowers are larger and of a bright yellow, much more conspicuous than those of the other vanilla.

The plants being climbers require supports, and in Mauritius the common shrub *Jatropha Curcas*, L., known here as "Jarak

Blanda" is used to grow them upon. In Mexico the forest is cleared of undergrowth climbers and large trees, and saplings left on which the vanilla climbs, or young fig trees are planted which serve as well. The wild vanilla I have seen, *V. Gardneri*, in Brazil, and our own wild species, *V. Griffithii*, grow in and through bushes which give them partial shade. Grown here on trellises and also on Erythrina (Dadap) trees or on posts like pepper, I find, for some reason, the plant becomes weak, the stems slender, the leaves small and yellowish green, and seldom flowers. Plants grown on an oil palm grew with remarkable vigour ascending to the top and hanging down all round. Of these plants both kinds grew equally well. Both flowered at the same, time, and set fruit after being fertilized. The objection to this plan of cultivation is that the flowers were, in many cases, so high from the ground that it was not easy to get at them all to fertilize them. The Sago palm and the Sugar palm might be utilized in the same way for cultivation. In too dense shade the plants grow long and slender and do not flower, but partial shade seems necessary.

The plant is propagated very easily by cuttings. Even quite short ones, a foot or so long, can be used, but it is usual to make the cuttings four or five feet in length. These root very readily, and can be placed near the tree up which they are to climb. After two or three years the plant may be expected to flower and will continue to flower for many years.

The flower spikes appear here in November and March. One or two flowers on each opens every day and must be fertilized then, as they only last twenty-four hours. It is not considered advisable to fertilize more than five or six flowers on each spike, unless the vine is a very strong one and is bearing but few spikes.

The fertilization is effected by cutting through the small plate in the column of the flower which separates the male portion from the female (stigma) and pushing down the pollen into the latter. (It is not easy to explain this without a diagram, a good one of which may be found in Delteil's work, and it is also copied in "All About Spices" by A. M. Ferguson.) When fertilized, the flower does not drop off, but withers on the stem and the stalk, like ovary below the petals, begins to swell a little. The fruit grows for about a month, and then takes from three to five months to ripen. When they begin to get yellow at the end, they must be picked one by one as they ripen. They have no scent till they begin to dry when they turn black and exude a dark brown or red liquid, the "balsam of vanilla." The pods when gathered are sometimes plunged into hot water for half a minute and then the water being drained off, put on woollen cloth to dry in the sun. At night they are put in a closed box to sweat. After several weeks they become dark, chocolate colour free from moisture and quite pliable, and are then quite fit for export. They are made up in packets of fifty pods and packed in tight fitting tin boxes.

Vanilla-pods (vanilloes) are always high priced. They vary in value according to quality and size, the ordinary quality, 5½ to 6

inches long, is quoted at 19*s*. 6*d*. to 20*s*. 6*d*.; 7 to 7½ inches long, 29*s*. per lb. (Oct., 1896.)

Vanilla might be successfully grown in the drier part of the Peninsula, but the great rainfall in many parts militates against it. The plants flower very well and the fruit sets, but heavy rainfalls are very liable to cause it to fall unripe, and as they take a long time to ripen the chances of the fruits being destroyed by rainfall some time during their ripening are rather large. Curiously our wild vanilla (*V. Griffithii*, Rchb. fil.) fruits in December and January during the period of heaviest rain. It bears very heavily when old enough, but the fruits contain no vanillin though they are sweet and eatable like small plantains.

Works on Vanilla Cultivation:—

Delteil, La Vanille.

Kew Bulletin, 1888, p. 76; 1892, p. 212; 1893, p. 327; 1894, p. 206; 1895, p. 169.

GINGER.

Ginger.—Haliya of the Malays, is the under-ground stem of *Zingiber officinale*, Rosc., (*Scitamineæ*.) The plant is about a foot and-a-half tall, the stems covered with narrow, grassy leaves. The flower spike is usually produced on a leafless stem near the leafy stems, but I have seen it borne on the leafy stem. It consists of a club-shaped spike of green bracts, from which are put forth the flowers singly or two or three at a time. The flowers are greenish with an almost black lip, very short lived. The fruit appears to be quite unknown.

The plant is one of those cultivated ones which are not known to occur anywhere in the wild state. It is probably a native of the East Indian islands, but has never been found truly wild anywhere.

Ginger was known both to the Greeks and Romans and was in England before the Norman Conquest. It was introduced into America by F. de Mendonça, and being cultivated there was shipped from the West Indies as early as 1585.

It is now cultivated in most tropical countries to some extent especially in Jamaica, South America, Western Africa, India, China, and the Malay Peninsula. It has also been tried in Ceylon but apparently has dropped out of cultivation. No great quantity is grown in the Peninsula and its cultivation might very well be increased.

Two forms of the plant are grown here, one, Haliya Padi, has very narrow, grassy leaves, and is considered the best kind, the other, Haliya Bara, has broader leaves.

Cultivation.—The ground selected for ginger planting should be neither too damp nor too dry. Though not requiring shade like cardamoms, the plant does not thrive in very exposed places. The root stocks cut into small pieces are planted in ridges after the manner of potatoes, three inches below the surface and nine inches apart. In India, the ground is covered with leaves to keep it moist and manure half-an-inch thick is laid over this. In this

country the ground is not dry enough to require this treatment, but manure can be dug in between the rows in the same way as is done for indigo. The root-stocks soon throw up the leafy stems and when they are a foot and-a-half or two feet tall, there should be about eight of the rhizomes or races to each shoot. In about six months after planting, the races are fit to dig up. In countries with a dry season this is shown by the dying down of the leafy stalks. In our wet climate the plant does not die down, but the leaves become yellowish and the plant appears as if about to wither. A good crop yields four times the weight of the sets.

Good ginger when dug has large stout races, white and of regular shape. The taste is very hot and aromatic. It varies a good deal in this respect, some ginger being much less pungent than others.

Preparation.—This simply consists in washing and cleaning the races and drying them in the sun. In India, they are shaken about in baskets to get off the scales and skin before drying. Black ginger is scalded for a quarter of-an-hour before drying. White ginger is scraped and dried in the sun without scalding.

Preserved Ginger.—The races are taken up as soon as they are formed while young and tender and when the stalks are about five or six inches tall. They are scalded, peeled and washed in cold water for some three or four days.

A syrup of a pound of sugar to a pint of water is made, into which the beaten whites of two eggs are gradually stirred while the syrup is boiled. It is carefully skimmed and when cold poured on the ginger. After two or three days the syrup is poured off reboiled and skimmed, and when cold poured over again, and left for three days. It is then re-boiled and re-clarified and poured over the ginger again while hot. When the syrup becomes thick and the ginger transparent it is finished.

Two other species of *Zingiber* are cultivated by the Malays, namely, Bunglé, *Z. zerumbet*, Sm., a larger plant than the true ginger, with broader leaves, pubescent beneath, and thick rounded spikes of flowers, with red bracts, the flowers whitish yellow, the mid lobe of the lip rounded and merely notched at the end; and Lampoyang, *Z. cassumunaar*, Roxb., a somewhat similar plant, but the mid lobe of the lip is deeply cleft in two.

Both of these gingers are cultivated and to be found half wild in the villages. The rhizomes, which are yellowish inside, and of a rather faint aromatic flavour are used for flavouring food and in native medicine as carminatives. The Lampoyang formerly had a reputation as an antidote against the Ipoh poison used by Sakais and other tribes on their darts.

These plants grow very readily in partly shaded ground, but are so little used that their cultivation would not repay the labour.

TURMERIC.

Kunyet-Kunyet, *Curcuma longa*, L., is but little cultivated in the Straits Settlements considering the ease with which it can be grown and the demand for it. Dr. Watt (Dict. of Chemistry),

states that it is one of the most profitable crops in India. The plant has a stout root-stock which often throws out slender branches which enlarge into tubers, the former is the round turmeric of commerce, the latter is the long turmeric. The interior of the root-stock is of a bright orange colour, by which and the peculiar flavour the spice is readily known. The leaves are produced in a tuft two or more feet tall. They are ovate and plain green in colour, with long stalks. The flower spikes are borne in the centre of the tuft of leaves. They have large greenish white bracts, the uppermost ones being usually pink. The flowers which are white and fugacious are borne in the bracts.

The spice was known at least as early as 1563, under the name of Indian saffron (*Crocus indicus*), and has long been used as a dye stuff, and in native medicine and in spicing curries, &c. The plant is probably a native of Cochin-China or possibly of India, but no one seems to have ever found it certainly wild. It has long been cultivated in the Malay islands and China, and most especially in India. It grows well in Singapore and Malacca, and good samples of the rhizomes are often to be seen at our local shows.

Cultivation.—The culture of the plant is much like that for ginger. The ground is cleared of weeds and dug over (it is ploughed in India) and raised into ridges about a foot and-a-half wide, and nine or ten inches high. Portions of the root-stock are planted about a foot and-a-half apart and six inches deep. The first shoots are produced in about a fortnight. The rhizomes can be dug in a year but it is considered better to wait for a year and nine months. The soil should be good, but almost any soil which is not too wet will do for turmeric if well broken up. It does not grow well in our stiff, yellow clay, but if well dug and a little manure put in it can be grown even in that. It grows best here it appears in light shade. In India it is said to do best in open ground. It is probable that heavy manuring would give better results, but it does very well here with a comparatively small amount.

Preparation.—The rhizomes are cleaned and the roots taken off and boiled, sometimes with the addition of cow-dung to the water, sometimes in plain water, or they are put in a closed earthen-pot, and slowly heated. After this they are dried in the sun.

TEMU LAWAK.

Curcuma Zedoaria, Rox.—This is a large-leaved turmeric often cultivated by the natives for spicing curries. It grows very easily even among lalang grass.

The leaves are large and broad, bright green with a slash of brown colour in the centre. The flower spike appears from between the leaves and is cone like with the lower bracts green and the upper ones purple. The flowers appearing between the bracts are pale yellowish white. The rhizome is somewhat like that of the turmeric in shape, but the tubers borne on the slender branches are more spindle-shaped. The inside is white and the flavour aromatic but not very strong and not at all hot.

The plants are propagated by cuttings of the root-stock, the dried or fresh rhizomes are sold in the markets and drug-shops.

TEMU KUNCHI.

Koempferia pandurata is a small ginger-like plant, the leaves short and broad in a tuft from between which is emitted a short spike of very fugitive flowers, pink and white, produced one at a time. The rhizomes are small.

It is cultivated in the same manner as ginger, but they are dug up when the leaves wither after about four months.

The rhizomes are used in native medicine chiefly and have a great reputation among the Malays, but as it is but seldom cultivated it is a very expensive drug. It is used for coughs and as a carminative.

CHEKOR.

Koempferia Galangal, L.—A rather larger plant with broad leaves, sessile, and violet flowers in a spike in the centre. The rhizomes are small and aromatic.

The plant is cultivated by Natives in Singapore and the rhizomes are used for flavouring rice and for a carminative and cough medicine.

GALANGAL.

The greater Galangal or "Lankwas" of the Malays, *Alpinia Galanga*, Willd., is to be found in every village. Its root-stocks are used in flavouring curries as well as in native medicines. It is a tall, leafy plant about six or more feet tall, the stems bearing at the ends rather close panicles of greenish white flowers, a few of which open at a time.

The rhizomes are thick and nearly white inside, aromatic and hot, but less so than ginger.

The plant is readily propagated from cuttings of the root-stock and will thrive in almost any soil, especially if shaded.

The spice appears in the London market at times but is considered much inferior to the true Galangal, a Chinese plant (*Alpinia officinarum*, Hance) which is not cultivated here.

KANTAN.

Nicolaia imperialis, Horan, is a very beautiful plant, with tall leafy stems about twelve feet tall, and a cone-shaped head of flowers surrounded with broad, ovate bracts of a fine pink colour. It occurs wild in some parts of the Peninsula, but is often cultivated for its flowers. The young heads of flowers before the outer bracts begin to expand are used in curries by the Natives and are sold in the markets.

H. N. RIDLEY.